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Insufficiency of Currently used Dental Indices in Epidemiology

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Authors' contributions

This work was carried out in collaboration between both authors. Both authors have read and approved the final manuscript.

Commentary

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ABSTRACT

The World Health Organization (WHO) classifies oral diseases in two different ways: officially dental caries (K02) and gingivitis as well periodontal diseases (K.05) are diseases in the digestive system. In epidemiological surveys the so-called DMF-index values (D= decayed or M= missing or F= filled tooth/surface) are used in determining past and present caries experience and the Community Periodontal Index (CPI) of WHO is used for the region around the teeth. Prevalence may be defined as the proportion of a population that has a disease at a specific point in time. In epidemiology, a subject-specific approach is the only accepted practice which means that a patient has one or multiple diseases, the rest of the population being healthy. A certain "cut-off" value normally differentiates the healthy subjects from diseased ones. In oral epidemiology the index values are used to determine the "seriousness" of the oral diseases. Calibrated dentists/examiners may be educated in recording dental caries and attachment loss exactly at a high level of precision but unless these scientific recordings are "diagnoses", the observations represent disease detections and assessments only without providing any prevalence or incidence values of oral diseases. The reason for that is hidden in the fact that the tools for oral health determinations are different from those for the diagnosis of oral diseases by WHO.

Keywords: Dental caries; periodontal diseases; prevalence; Incidence; index-values; epidemiology.

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1. INTRODUCTION

John Snow was recently celebrated as the “father” of epidemiology. According to a review of conventional and unconventional applications of epidemiology, “as is the situation in many epidemiological studies, a key issue is the definition of a case” [1]. Indeed, even the World Health Organization (WHO) reports that oral diseases have a high incidence and prevalence but it does not provide any relevant scientific information for this claim. WHO does not provide any rigorous determination of the oral “cases” because the official determinations of dental diseases in the International Statistical Classification of Diseases and Related Health Problems (ICD) [2] are completely different from those in WHO´s Oral Health Surveys [3].

2. INTERNATIONAL CLASSIFICATION OF DISEASES BY WHO

Officially, in the ICD [2] , WHO classifies dental caries as a disease in the digestive system (code K) as follows: caries limited to enamel (K02.0), caries extending into dentin (K02.1), caries of cementum (K02.3), odontoclasia (K02.4), other specified dental caries (K02.8) and unspecified dental caries (K02.9).The gingivitis and periodontal diseases (K05) family contains acute periodontitis (K05.2), chronic periodontitis (K05.3) and periodontosis (K05.4), presently termed as “aggressive periodontitis”. The tenth revision of the publication (ICD-10) [2] and its dental application (ICD-DA) [4] are presently in use (except in the United States). The ICD provides the basis for the diagnosis of diseases.

The official ICD classification has been commonly accepted in many countries where it has been adopted as an official disease nomenclature. Disease diagnoses made in the United States are based on the ICD and the International Classification of Functioning, Disability and Health (ICF) [5], which is combined for making official diagnoses in North America [6]. The National Center for Health Statistics (NCHS) serves as a WHO Collaborating Center for the Family of International Classifications for North America and in this capacity is responsible for the coordination of all official disease classification activities in the United States relating to the ICD and its use, interpretation and periodic revision. Presently, a transition from ICD-9-CM to ICD-10-CM (by October, 2014) is underway [6]. In Finland, also dentists are obliged to use the ICD in their diagnoses.

3. ORAL HEALTH SURVEY CLASSIFICATION BY WHO

Dental scientists have also produced the Oral Health Surveys [3] which use the so-called DMF-index (D= decayed or M= missing or F= filled tooth/surface) in determining past and present caries experience but unfortunately, at the same time which is never possible [7]. The WHO determination maintains that the D component of the index includes all “decayed” or “decayed/filled” teeth as “dental caries” in cases where a restored/non-restored tooth has “an unmistakable cavity”, meaning in practice caries extending into dentin. This WHO manual also uses the Community Periodontal Index (CPI) as an indicator of periodontal status from the region around the teeth. These indices determine oral diseases in a completely different way.

4. EPIDEMIOLOGICAL PRACTICES

Prevalence may be defined as the proportion of a population that has a disease at a specific point in time and lifetime prevalence as the proportion of population that has had the disease at some time during their lives [8]. In epidemiology a subject-specific approach is always the

accepted practice. This means that a patient has one or multiple diseases, while the rest of the population is healthy. In statistical analyses, diseased or healthy subjects determine the number of cases (N).

In dental epidemiology, however, this principle has not been followed and consequently, a tooth-specific approach exists, meaning that each tooth is either diseased or sound and that the number of teeth equals N. This is certainly misleading for example, because restored or missing teeth are not necessarily “past-carious” and both states may additionally be due to fractures.

The tooth-specific mean DMF-index values are used in describing present caries (D) or past caries (M and F) in the dentition, but this index was originally intended for the assessment of treatment need in elementary school children [9]. The use of mean dental index values (of DMF or CPI) has resulted in a quantification of caries or periodontitis seriousness that is not in congruence with current epidemiological practice. A subject is either healthy or has a disease, regardless of its severity which is always another disease in the ICD, like is caries in enamel or dentin.

This practice has resulted in another discrepancy in dental epidemiology: determination of the prevalence of healthiness in terms of DMF-value being zero. The oral health report by the National Health and Nutrition Examination Survey (NHANES) for example, determines as “diseased” those whose DMF-value is over zero meaning in practice “untreated” or more probably “treated” (restored) teeth. The recently launched T-Health index weights decayed, missing, filled or sound teeth by different numbers [10].

5. SOUND VERSUS DISEASED SUBJECTS

A certain “cut-off” value normally differentiates healthy subjects from diseased ones. For example, the cut-off value of body temperature, to determine “fever” is 37ºC, meaning that the patient has a “one-degree-fever” when his/her body temperature is 38ºC. However, this does not mean that his/her disease condition equals only 1/3 of a fever patient whose body temperature is 41ºC, as is the dental practice, when the DMF-value is one instead of three. The dental practice is also confusing: the value of this index represents caries, restoration, or missing tooth, due to caries under age 30 years, all of which represent completely different states of tooth. In fact, the DMF-index values should indicate “lifetime” prevalence of dental caries in each tooth [8] but their mean values do not represent the “lifetime” prevalence of caries of the same subject. Therefore, it is presently termed caries “experience”.

The determination of the D, M and F components of the DMF-index is misleading: dental restoration (F-component) is not caries or another dental disease. The M-component should be used for teeth that have been extracted because of caries but after the age of 30 years, “missing teeth for any other reasons” are also accepted in the index [3]. At age 30, a totally edentulous patient turns “carious” with the DMF-index value at its maximum, although he/she may never have had caries.

The WHO recommendations shown in the Oral Health Surveys [3] lead to a diagnosis that is outright wrong. The “missing teeth” disease category in the official ICD includes at least five different diseases revealed by the patient´s history: anodontia (K00.0), embedded teeth (K01.0) and impacted teeth (K01.1). Exfoliation of teeth due to systemic causes (K08.0)

results in missing teeth, as does the large group of diseases in the "loss of teeth due to accident, extraction or local periodontal disease" category (K08.1).

Several national probability surveys have assessed the periodontal status of the U.S. population. The latest one estimated the prevalence, severity and extent of periodontitis in adults [11,12], the latter with data from the 2009 and 2010 NHANES. In fact, both surveys collected probe measurements of attachment loss and probing depths and grouped attachment loss into categories of "seriousness". This approach does not fulfil any criteria for making a diagnosis of periodontal disease, tentative diagnosis using ICP-index or lawful diagnosis using the ICD, because periodontal diseases are not categorized based on their "seriousness" into different diseases in the ICD. It is a pity that periodontologists have adopted the practice of quantification of disease from their cariology colleagues.

6. ONE OR MULTIPLE DISEASES

Recently Larmas et al. [13] suggested how to solve the problem of quantification of disease severity at the patient level: he/she may have "caries in one or multiple teeth" or "each tooth has its own caries" resulting in 32 carries cases in permanent teeth and 20 in primary. The tooth-specific classification does not fit into the present ICD but has on the other hand, no obstacles in conducting oral research in epidemiology.

This practice adheres to medical practice: each bone may have one or multiple fractures like for example the mandible, which may have altogether 8 types of fractures in the ICD-DA (4). Blindness may concern both eyes and is classified in the ICD as "blindness, binocular "(H54.0). If blindness concerns only one eye, it is classified "blindness, monocular" (H54.4) with completely different impairment and seriousness. In fact, monocular blindness equals a completely edentulous status.

The survival of teeth caries-free in the oral cavity is dependent on tooth type, so that molar teeth are most vulnerable to caries: caries prevalence in all first molars is around 10% at about ten years of age in Finland [14]. Later, at the age of 16 years, the same caries prevalence was seen in second molars, in all premolars and maxillary incisors. Tooth surface-specific analysis has revealed that proximal caries is caries type in maxillary incisors and all premolars. No mandibular incisors or canines became carious during follow-up before the age of 20 [14]. Thus, a tooth-specific approach is a necessity in caries epidemiological research just like cases of bone or tooth fractures in medical practice.

7. DIAGNOSIS VERSUS DISEASES ASSESSMENTS

According to Papapanou [15], regarding the research report on periodontitis prevalence in the U.S [12], "prevalence is critically dependent on the `case` definitions used and a universally accepted definition of periodontitis has yet to be established". This comment underestimates the work in the NCHS [6] in the U.S. Clinical attachment loss in millimeters is a symptom or trait/measure in clinics versus research to describe the periodontal disease. They constitute a tiny part of the diagnosis, which only a licensed doctor or dentist has the authority to make.

Diagnosis of the presence of disease is often overruled in dental science. Calibrated dentists/examiners may be educated in recording dental caries and attachment loss exactly at a high level of precision but unless these scientific recordings are "diagnoses", the

observations represent disease detections and assessments only. Indeed, the current National Institute of Dental and Craniofacial Research (NIDCR) strategic plan states that "Documenting the nation's prevalence of the full range of oral, dental and craniofacial diseases is an important element of a strategic investment in basic and clinical research…. The NIDCR will seek and validate new methods to measure and document oral, dental, and craniofacial diseases, disorders and conditions" [16].

Diagnosis presumes additionally at least *(i*) anamnesis, (*ii*) clinical and radiological examinations recorded in the dental chart, and sometimes (*iii*) clinical *in vitro* tests *e.g*. for the evaluation of frequent sugar intake by the Dentocult test [17] or the activity of the progression of periodontal disease, *e.g*. by means of Loesche´s BANA-test [18].

We believe that dental caries and periodontitis are among the most widespread chronic, infectious, non-communicable diseases among humans and that as researchers in dentistry, we are dismayed that these diseases have remained as the only two ailments without sufficient scientific knowledge of their real global prevalence or incidence at different ages. Today (27.12.2013) a search by the term "caries prevalence" reveals 11,196, "caries incidence" 11,030 and "caries experience" 2735 articles in the PubMed, the last "experience" figure being closest to the truth. All other thousands of scientific reports do not cover "prevalence" or "incidence" though PubMed believes so. Dental epidemiologists report that at 12 years of age the global average for dental caries was still no more than 3 DMFT [19], i.e. the first measurable goal for the year 2000, announced by WHO in its World Health Assembly as early as in 1979.

8. DENTAL EPIDEMIOLOGY

In 1971, Dr. David E. Barmes introduced the Oral Health Survey Manual [3], a widely used piece of work, and whose 4th edition was published in 1997. He established the Global Oral Data Bank (GODB), presently the Oral Health Database [19] in 1969 and introduced the CPITN (presently ICP) Index. Unfortunately, all of these achievements by Dr. Barmes further distanced dental epidemiology from the medical one, as described above.

Are we now underestimating Dr. Barmes´s role as a dental epidemiologist? We fully agree that at the international level, he took oral health out of obscurity, put prevention at the foreset global goals and made these goals an integral part of the "Health for All" movement but unfortunately by exploiting weapons of the past. However, fortunately, he did initiate the development of the "official" ICD-DA [4] classification paving the way for dental epidemiology to return to the medical one, i.e. to the present goal of NIDCR [16]. The action plan and the resolution on oral health that Dr. Barmes elaborated decades ago are a tribute to the high status oral health now holds in the development agenda, hopefully in both WHO and NIDCR.

9. CONCLUSION

WHO classifies oral diseases in two different ways that distance dental epidemiology from the medical one. The official ICD classification paves the way to return to scientific epidemiology.

CONSENT

Not applicable.

ETHICAL APPROVAL

Not applicable.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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